

VACUUM-SUSPENDED SHOE

This application claims priority to U.S. Provisional Patent Application Serial No. 60/422,963, filed on November 1, 2002 and entitled VACUUM-SUSPENDED SHOE, which is herein incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for suspending footwear, such as a shoe, from the human body by means of vacuum.

SUMMARY OF THE INVENTION

One embodiment of the present invention relates to an apparatus for use on a foot that includes a support portion, a first material within the support portion and enclosing a space in which a foot may be placed, a pump embedded in the heel, and a conduit connecting the pump to the space.

Another embodiment relates to a method for removing fluid from within footwear. The steps of this embodiment can include providing a first material within the interior of the footwear that forms a space into which a foot can be placed and drawing a vacuum against the space after a user's foot is inserted into the footwear.

Another embodiment of the present invention relates to a method for changing the fluid pressure from within footwear. One step could be to provide a first material within the interior of the footwear. Another step could be to provide a fluid conduit that enables fluid to flow at least one of in and out of the interior. Still another step could be to control fluid flow in or out of the interior through the fluid conduit after a user's foot is inserted into the footwear to change the fluid pressure within the interior.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic cross-section of one embodiment of the invention in place on the foot.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In one embodiment the apparatus 10 comprises a support portion such as an outer portions such as a shoe shell 12, with a flexible material 14 therein, wherein the material 14 is preferably urethane. The flexible material 14 can be bonded to the shoe shell 12. The flexible material 14 can cover the entire foot and provide a air seal at, for example, the patient's ankle A.

The patient can don a sock 16 or another lining material. Preferably, the sock 16 should not extend above the flexible material 14. The sock 16 can act as an air wick between foot F and the flexible material 14. The sock can absorb, hold, or wick away perspiration.

The apparatus 10 can further include a vacuum pump 18 or other means for reducing pressure. In the preferred embodiment, the vacuum pump 18 is in the heel 20 of the shoe shell 12. A conduit, such as a hose or tube 22, connects the vacuum pump 18 to the inside of the flexible material 14, between the flexible material 14 and the foot F. As the patient walks, the heel-resident vacuum pump 18 is compressed during stance phase and fluid (e.g., air, water vapor, etc.) can be expelled to atmosphere. During the swing phase of walking the heel-resident vacuum pump 18 returns to its normal shape, pulling fluid from between the flexible material 14 and the foot F (and through the sock 16, if one is used), thus creating a vacuum, i.e., lowered pressure, to hold the foot to the inside of the flexible material 14.

The apparatus 10 can further include a one-way valve 24 between the vacuum pump 18 and the hose 22, and a second one-way valve 26 between the vacuum pump 18 and atmosphere. Any suitable one-way valve may be used for the valves 24, 26, such as a duckbill valve or a ball valve with a seat and spring. The valves 24, 26 control the flow of air and substantially stops air from being pumped into the space between the flexible material 14 and the foot F.

Preferably, the shoe shell 12 is composed of a substantially rigid material that stops the shoe shell from collapsing on the foot as vacuum is drawn.

The apparatus may have a mid-dorsal opening 30 with a closure means such as Velcro or shoelaces to allow the patient to don the shoe.

When used to create a lower pressure environment (than ambient) for a foot, the apparatus has application in the removal of moisture (liquid or gas) from the foot or between the foot and shoe. It can also be useful for providing a close fit of a shoe, boot, or the like on the foot, as in downhill ski boots, which could involve the use of conformable shoes, boots, and the like. Still further, the apparatus could also be used to increase or maintain blood flow to the foot, if such flow is desired.

Or, the apparatus could be reconfigured to increase the pressure upon the foot, i.e., to provide a higher pressure environment (than ambient) for a foot. This could be a way of maintaining or reducing fluid volume in the foot. E.g., forcing air between the material 14 and the foot could prevent pooling of fluid in the foot or even drive fluid out of the foot. Preferably, the material 14 would be substantially incompressible or inelastic such that the increased pressure between the material 14 and the foot would result in at least a certain amount of pressure being applied to the foot rather than resulting entirely in the compression or stretching of the material 14. Or, the higher pressure environment could be created outside the material 14, for example, between it and another layer of material 14.

The apparatus could be operated such that pressure is changed, for example, periodically. That is, it could be changed back and forth between higher pressure and neutral (or ambient) pressure, higher pressure and lower pressure, neutral pressure and lower pressure, or some combination of higher, lower, and neutral pressures.

Further, though the apparatus is shown in terms of a shoe configuration, it could also be useful configured as a boot that goes to or above the user's ankle. This boot could include material 14 such that the pressure chamber created therein either ends where shown in Fig. 1 or extends further up the boot.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive. For example, components or portions of the apparatus 10 described above could, in themselves, be provided separately but still provide some or all of the benefits noted above.